WATERSHED MANAGEMENT AREA 6
UPPER PASSAIC RIVER DRAINAGE

The watershed management area represents the area drained by waters from the upper reaches of the Passaic basin including the Passaic River from its source down to just before its confluence with the Pompton River. This region is characterized by extensive suburban development and heavy reliance on ground water sources for water supply. The area lies in portions of Morris, Somerset and Essex Counties and includes the following watersheds:

Upper Passaic River Whippany River Rockaway River

Summary of ambient physical/chemical monitoring stations and classifications:

Station	Classification
Passaic River near Millington	FW-2 Nontrout
Passaic River near Chatham	FW-2 Nontrout
Passaic River at Two Bridges	FW-2 Nontrout
Rockaway River at Boonton	FW-2, Nontrout
Rockaway River at Pine Brook	FW-2 Nontrout
Whippany River at Morristown	FW-2 Nontrout
Whippany River at Pine Brook	FW-2 Nontrout

OVERALL MANAGEMENT AREA ASSESSMENT

- Swimmable Support Status:

WATERWAY	LOCATION	STATUS
Passaic River	near Millington	Partial Support
Passaic River	near Chatham	No Support
Passaic River	at Two Bridges	Partial Support
Rockaway River	at Boonton	Partial Support
Rockaway River	at Pine Brook	Partial Support
Whippany River	at Morristown	No Support
Whippany River	at Pine Brook	No Support

- Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed management area.

No Impairment: 14 Mod. Impairment: 22 Severe Impairment: 7

MAPS here

UPPER PASSAIC RIVER

WATERSHED DESCRIPTION

The Upper Passaic River, from the source to the confluence of the Pompton River, is nearly 50 miles long and drains approximately 200 square miles of eastern Somerset, southern Morris and western Essex Counties. The river represents a significant source of drinking water for a large portion of northeastern New Jersey.

Major tributaries include the Dead River, Rockaway River, Whippany River and the Black Brook. There are no large impoundments, but smaller ones include the Canoe Brook Reservoir, Osborn Pond and Van Dorens Mills Pond. The areas adjacent to the Passaic River are subject to frequent flooding. The population centers are Madison-Chatham, Florham Park, Bernards, Berkeley Heights and New Providence.

Approximately one-half of the land in this watershed is undeveloped or vacant, with the remainder primarily residential and commercial. This Watershed is facing significant development in the vacant areas. There are some 30 NJPDES permitted discharges identified in this watershed, of which slightly more than half are municipal and the rest are industrial/commercial. The streams of the Upper Passaic River Watershed have been classified primarily FW-2 Nontrout, but some FW-2 Trout Production waters are present.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Location: Passaic River near Millington

Dissolved Oxygen: Depressed. Seventeen percent of samples were below the 4.0 mg/l criterion for non-trout waters. Daytime values as low as 2.4 mg/l were recorded and the median value was 5.8 mg/l. These are close to mid-day readings; we expect night-time conditions to be significantly poorer.

Temperature: No violations of the upper criterion for non-trout waters.

Nutrients: Inorganic nitrogen (nitrate+nitrite) at low levels. Total phosphorous is, in contrast, quite elevated, with 60% of samples exceeding the criterion. The median value was 0.12 mg/l.

Passaic River near Millington continued:

Bacteria: Fecal coliform levels are marginally elevated, showing a geometric mean of 136 MPN/100 ml, with 25% of samples exceeding 400 MPN/100 ml.

Heavy Metals: All at acceptable levels, however, one copper sample and one lead sample were elevated during the early portion of the period of review. These metals should be carefully monitored at this location.

Location: Passaic River near Chatham

Dissolved Oxygen: Acceptable for nontrout waters, however, this location is threatened with several recordings that closely approached the 4 mg/l lower limit.

Temperature: No violations of the upper criterion for non-trout waters.

Nutrients: Inorganic nitrogen (nitrate+nitrite) at moderate levels; median value is 0.815 mg/l. Total phosphorous levels are very high, with 90% of samples exceeding the criterion. The median value was 0.29 mg/l.

Bacteria: Highly elevated; geometric mean for fecal coliform is 717 MPN/100ml.

Sodium: Elevated. Forty percent of the samples collected during the assessment period exceeded the 50 mg/l criterion. Median value was 46.5 mg/l. Violations occurred in both mid-winter and mid-summer and fall, indicating that winter road-salting was not the only significant source.

Heavy Metals: Records indicate acceptable levels. One lead value during the early portion of the assessment period, although within standards, did approach the limits of acceptability, suggesting that this metal could be a potential problem at this location and should be monitored.

Location: Passaic River at Two Bridges

Dissolved Oxygen: Acceptable for nontrout waters, but threatened; violations limited to 2% of samples.

Temperature: Violations of the upper criterion for non-trout waters limited to 2% of samples.

Nutrients: Inorganic nitrogen (nitrate+nitrite) at elevated levels; median value is 3.15 mg/l. Total phosphorous levels extremely elevated, with 95% of samples exceeding the criterion. The median value was 0.52 mg/l.

Bacteria: Fecal coliform at marginally unacceptable levels with a geometric mean of 140 MPN/100ml and 25% of samples exceeding 400 MPN/100ml.

Passaic River at Two Bridges continued:

Sodium: Elevated. Thirty-seven percent of the samples collected during the assessment period exceeded the 50 mg/l criterion. Median value was 41 mg/l. Violations were not restricted to winter, indicating that winter road-salting was not the only significant source.

Heavy Metals: Records indicate lead exceedances of chronic criteria to be common; four out of five samples exceeded the criteria.

Summary: Dissolved oxygen level is depressed at Millington but recovers further downstream near Chatham and remains stable through Two Bridges. In regard to nutrients, water quality worsens in a downstream direction. Phosphorus is severely elevated throughout and progressively worse as one proceeds downstream. Inorganic nitrogen is acceptable at Millington but elevated at the two more downstream stations. By the time water flow has reached Two Bridges, the Passaic River has been subjected to numerous municipal wastewater discharges. These discharges severely challenge the limited assimilative capacity of the river. On the positive side, toxic ammonia levels, a significant problem in the past in the Passaic River, were found to be very low.

Sanitary quality is marginal at Millington, poor near Chatham, then again marginal downstream at Two Bridges. Sodium levels are acceptable at Millington, but elevated at the two downstream monitoring sites.

Elevated lead threatens the quality of the Passaic. Levels were elevated but within water quality criteria at Millington and Chatham, but frequently exceeded the chronic criteria at Two Bridges. In the past, portions of the upper Passaic River have been regarded by the Department as impaired due to toxic discharges emanating from point sources; the river is thus listed in the State's 303(d) list. The contaminants of concern were cyanide, arsenic, copper, mercury, cadmium and lead. The criteria violated are USEPA's Federal Aquatic Life chronic criteria and USEPA's Federal human health criteria. The Department will be instituting an intensive review of all current data in order to determine if these concerns are still warranted.

Biological Monitoring

The macroinvertebrate communities within these portions of the Passaic River vary from moderately to severely impaired. Only one location, near Millington, was judged to be non-impaired when assessed in 1993. This fact lies in contrast to the depressed dissolved oxygen levels recorded at the chemical monitoring station near this location. Further downstream, in the Chatham and Hanover areas, the river is assessed as severely impaired. Biological health of the tributaries to the upper Passaic varied from non-impaired (Dead River and some of its tributaries) to severely impaired (Black Brook, portions of Loantaka Brook). See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the Watershed.

POINT SOURCE ASSESSMENT

There are no reported Department enforcement actions currently underway against facilities that are impacting surface water quality. A significant number of plants have been upgraded or eliminated (see table below).

Hazardous waste sites reported in the past to have been contaminating surface waters in this watershed are the Chevron site in Berkeley Heights releasing PCBs and volatiles to the Passaic River, and the Millington Asbestos site, releasing asbestos to the Passaic River. A soon-to-be-scheduled watershed characterization for the Passaic River Watershed will serve to update this information.

The following wastewater treatment plants have been upgraded, expanded or eliminated:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Southeast Morris Co. MUA	Hanover Twp.	Black Brook	Discharge contained violations of residual chlorine, COD and suspended solids. In June 1995 the facility ceased its discharge to the Black Brook and tied into Florham Park SA.
Precision Rolled Products	East Hanover Twp., Morris Co.	Black Brook	Facility discharged treated sanitary and industrial wastewater. Permit limit violations were for DO, suspended solids, ammonia, total residual chlorine. An AO issued in 1990 has resulted in improved industrial housekeeping and closure of their STP. Sanitary wastewater is now hauled off-site; industrial wastewater continues to be discharged at the site.
Warren Twp. Stage IV STP	Warren Twp., Somerset Co.	Dead River	Treatment system has been upgraded via an ACO executed with the DEP. Upgrades were required due to violations of effluent limitations. Upgrade completed in February 1992.
Chatham Twp. Main STP	Chatham Twp., Morris Co.	Black Brook	Treatment system has been upgraded via an ACO executed with the DEP. Upgrades were required due to violations of effluent limitations. Upgrade completed in March 1992.
Long Hill Twp. STP	Long Hill Twp., Morris Co.	Passaic River	Treatment system has been upgraded via an ACO executed with the DEP. Upgrades were required due to violations of effluent limitations. Upgrade completed in August 1992.
Bernardsville Boro STP	Bernardsville Boro, Somerset Co.	Mine Bk.	Facility has completed an upgrade of its wastewater treatment system via an ACO executed with the Department.
Woodland STP	Morris Twp., Morris Co.	Loantaka Brook	Treatment system has been upgraded via an ACO executed with the DEP. Upgrades were required due to violations of effluent limitations. Upgrade completed in November 1993.

NONPOINT SOURCE ASSESSMENT

The Passaic River is impacted by the extensive urban/suburban development which has occurred throughout much of its watershed. In the uppermost stretches (the Great Swamp region), local housing construction and the construction of a gas pipeline are suspected of contributing to localized stream habitat destruction. As the river flows from the Great Swamp region to Chatham, the degree of development within the watershed becomes greater. Septic seepage, road and building construction and urban surface and road runoff all impact the Upper Passaic River. Florham Park and Chatham are reported to have a highly developed stormwater infrastructure,

suggesting that stormwater outfalls may be a significant source of pollution to the river in this area.

The impacts to the river from urbanization increase in severity along the stretch from Chatham to Livingston. Siltation is suspected of being the principal agent of habitat destruction in this portion of the river. It is here that the Division of Fish and Game reports that the fishery begins to noticeably degrade, so that few game species are present. Those species which do survive are largely limited to pollution-tolerant forms such as carp and goldfish. Between Livingston and the Pompton River confluence, habitat destruction continues to rise in severity. This destruction has been brought about largely by dredging, channelization, the removal of riparian vegetation, as well as ever-increasing silt loads. Stream bank erosion and urban runoff appear to be common problems along the Passaic and many of its tributaries.

DESIGNATED USE ASSESSMENT

The Upper Passaic River will fully support the "aquatic life" use only in one portion of the river, namely the region around Valley Road near Millington. The remaining assessed portions varies from partial to non support depending upon the location. Macroinvertebrate assessments have not gone beyond the Passaic River in East Hanover.

The Passaic River sanitary quality as based upon fecal coliform levels at Millington and Two Bridges would partially support primary contact recreation (swimming). Sanitary quality is poor at the Chatham site; hence, this location is not swimmable.

ROCKAWAY RIVER

WATERSHED DESCRIPTION

The Rockaway River has a drainage area of 133 square miles that is mostly within Morris County with a small portion in Sussex County. It flows east to a confluence with the Whippany River at Pine Brook. Major tributaries to this 37 mile long river include Stone Brook, Mill Brook, Beaver Brook and Den Brook. There are many lakes and ponds in this area, but the major impoundments are Mountain Lakes Reservoir, Upper Longwood Lake, Boonton Reservoir, Taylortown Reservoir, Splitrock Reservoir, White Meadow Lake and Lake Denmark. The population centers include Boonton, Randolph, Montville, Kinnelon and Dover.

The land use patterns in this area are complex and include wooded/vacant areas, park lands, and residential development, with some areas having industrial and commercial uses. Development is occurring in much of the vacant area. There are approximately 30 NJPDES permitted dischargers here, of which about two-thirds are industrial/commercial and one-third are municipal. Waters in this drainage basin have been rated FW-2 Trout Production, FW-2 Trout Maintenance, FW-2 Nontrout and FW-1.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Locations: Rockaway River at Boonton and at Pine Brook

Dissolved Oxygen: Acceptable at both locations.

Temperature: No violations of the upper criterion for non-trout waters.

Nutrients: Inorganic nitrogen low at Boonton. Phosphorus also low when compared to Pine Brook, however, the location just upstream of a reservoir requires that Boonton be assessed using the more restrictive phosphorus criterion of 0.05 mg/l. Using this criterion, 29% of the phosphorus recordings exceeded the standard. The median total phosphorus value was 0.03 mg/l.

At Pine Brook conditions degrade noticeably. Inorganic nitrogen is very high, with a median value of 3.13 mg/l, but with individual values as high as 8.93 mg/l. Total phosphorus is also elevated; the median values was 0.145 mg/l, with 72% of samples exceeding the criterion (0.10 mg/l). At Boonton, in contrast, only one phosphorus recording exceeded 0.10 mg/l (6% of the samples).

Bacteria: At Boonton, fecal coliform levels are marginal. Geometric mean is 107 MPN/100ml, with 17% of samples exceeding 400 MPN/100ml. At Pine Brook, again fecal coliform levels are marginal; geometric mean is 171 MPN/100ml, with 35% of samples exceeding 400 MPN/100ml .

Rockaway River continued:

Sodium: Acceptable at Boonton. At Pine Brook, sodium is elevated and just within the water quality criterion. Several records above 40 mg/l were encountered in summer and fall, not in winter.

Heavy Metals: One lead record out of four exceeded the chronic criterion for aquatic life support at Boonton. At Pine Brook one high record (out of five) again exceeded the chronic criterion. Pine Brook, is also threatened by copper, levels of which are within standards, but are somewhat elevated.

Summary: Generally speaking, the Rockaway River is of good quality above the Boonton reservoir, but has fair quality below it as measured at Pine Brook. The later location exhibits elevated nutrients, sodium and lead. Sanitary quality at Boonton and Pine Brook is marginal. Lead is also a problem at Boonton.

Conditions are very similar to the previous physical/chemical assessment presented in the 1992 Inventory Report using records from 1986 through 1990 (inclusive). One notable exception is a reduction of fecal coliform levels (expressed as geometric means) at Pine Brook. In this previous assessment, fecal coliform samples had a geometric mean of 503 MPN/100ml. This is notably higher than the bacterial levels observed in the still earlier 1983-1987 assessment when the geometric mean was determined to be 169 MPN/100ml. Hence, it appears that the geometric mean (in our present assessment) has returned to the levels originally observed in the mid-1980s.

Biological Monitoring

Macroinvertebrate assessments suggest that the upper-most portion of the Rockaway River in Jefferson Township is moderately impaired. Further downstream, in Randolph Township, Denville and Boonton (above the reservoir), the river is assessed as non-impaired. Below the reservoir, the Rockaway is moderately impaired.

Assessment results of tributary streams varied. Russia Brook and Mill Brook were non-impaired. Beaver Brook and Crooked Brook indicated portions of non-impairment and portions of moderate impairment. The only severely impaired location was Den Brook as monitored in Denville.

POINT SOURCE ASSESSMENT

Point source facilities in non-compliance as well as those formerly under enforcement action that have improved their discharges are listed in the point source tables below. Only one facility is under a Department enforcement action.

Two hazardous waste sites located in the Rockaway Watershed were suspected of contaminating surface waters in the past. These were Sharkey Landfill in Parsippany-Troy Hills and L.E. Carpenter in Wharton Borough. A future characterization report will update their status.

A permitted wastewater discharge within the watershed was reported to be in noncompliance with its discharge permits:

FACILITY	LOCATION	RECEIVING WATER	POLLUTANT	COMMENTS
White Rock STP	Jefferson Twp., Morris Co.	tributary to Mitt Pond	Total phosphorus and primary tank overflows	The STP has had frequent effluent violations as well as primary tank overflows. Enforcement action is under way. The plant is undergoing minor modification at this time.

The following wastewater treatment plants have been discontinued:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Randolph High School STP	Morris Co.	Mill Brook	Treated sanitary wastewater contained violations of nitrogenous BOD, DO, ammonia and cBOD. Facility was decommissioned in February 1993.
Berkshire Sand and Stone Co.	Jefferson Twp., Morris Co.	Middle Brook/Rockaway River	Discharge of process and storm water contained violations of total suspended solids. Following seizure by the IRS in 1993, operations and all discharge ceased.

NONPOINT SOURCE ASSESSMENT

The Rockaway River from Dover down to the Passaic River is impacted to varying degrees by urban/suburban development; this impact increases in severity as one travels downstream. Construction activities and urban runoff from storm sewers and urban surfaces have resulted in siltation, high stream temperatures and losses of riparian vegetation - all of which contribute to a general decline in water quality. In the stretch between Dover and the Boonton Reservoir this degradation has led to a reduction in the stream's trout holding capacity. Further downstream of the reservoir, the impacts from these sources become more severe.

Many other streams in this watershed are also impacted by urbanization. Construction and urban runoff (sewers, urban surfaces) have degraded Jackson Brook, where fish kills have been documented in the 1980s. Beaver Brook is reported to be impacted by intensive road and housing construction. Development has been so severe around Den Brook that it has led to complete habitat destruction within the stream.

DESIGNATED USE ASSESSMENT

The Rockaway River will fully support the "aquatic life support" designated use in the segment within Randolph Township, Denville and Boonton (above the reservoir). In Jefferson Township and the segment below the reservoir, the Rockaway River partially supports the use. Various tributaries either fully support (Russia and Mill Brooks), partially support (portions of Beaver and Crooked Brooks), or do not support the "aquatic life" designated use (Den Brook).

The river is regarded as partially supporting primary contact recreation (swimming) because of marginal fecal coliform bacterial levels at Boonton and Pine Brook.

WHIPPANY RIVER

INTRODUCTORY NOTE

Significant portions of the information presented for the Whippany Watershed in this report are drawn from the *Whippany River Watershed Characterization Report*, prepared by the NJDEP's Office of Environmental Planning. As such, the level of information presented for the Whippany region is extensive compared to other watersheds in this report. These detailed assessments will be developed through the department's Watershed Management Program, of which the Whippany serves as a pilot program. Copies of the *Whippany River Watershed Characterization Report* are available from the New Jersey Department of Environmental Protection, Office of Environmental Planning, CN 418, Trenton, NJ, 08625.

WATERSHED DESCRIPTION

The 69.3 square mile Whippany River Watershed is located entirely within Morris County and encompasses 14.3% of the County. The river flows 18 miles to the New River near East Hanover, directly upstream of the confluence with the Passaic River. Two of the larger tributaries to the Whippany are Black Brook and Troy Brook. Major impoundments include Clyde Potts Reservoir, Speedwell Lake and Pocahantas Lake. The population is centered in Morristown, Parsippany-Troy Hills, Hanover Township and East Hanover Township.

The Whippany River Watershed has been divided into three subwatersheds. The Upper Whippany subwatershed constitutes 20 percent of the watershed and is 14 square miles. It includes the headwaters to just above the Butterworth Sewage Treatment Plant in Morris Township. The Middle-Lower subwatershed with inputs from Black and Malapardis Brooks is 39 square miles and comprises 57 percent of the watershed. The Troy Brook subwatershed is located from its headwaters in Mountain Lakes Borough to just prior to the confluence with Smith Ditch/Whippany River. It is 16 square miles and is 23 percent of the Watershed.

Surface Water Quality: Stream Classifications

The following classifications are from the Surface Water Quality Standards (N.J.A.C. 7:9B) of April 1994. The Whippany is composed of the Brookside tributary, which is classified as FW2-TP(C1) from its source to Whitehead Road bridge, and the Morristown tributary, which is classified as FW2-NT extending from the Whitehead Road bridge in Morris Township to the Rockaway River. The tributaries of the Whippany River are classified as follows:

Brookside (entire length)	FW2-TP(C1)
East of Brookside (entire length)	FW2-TM
East of Washington Valley (entire length)	FW2-TM
Gillespie Hill (entire length)	FW2-TP(C1)
Shongum Mountain (entire length)	FW2-NT

FW = fresh water
TM = trout maintenance
TP = trout production
NT = nontrout waters
C1 = category one waters

Land Use In The Subwatersheds
The following information was generated from a GIS coverage from the United States Geological Survey Land Use Land Cover Classification System.

Land Use Per Subwatershed:

Subwatershed	Land Use	Area Square Mile	Percent
Upper Whippany	Agriculture	.50	3.60
	Barren Land	0	0
	Forest	8.51	61.10
	Urban Land	4.68	33.60
	Water	.11	.79
	Wetlands	.12	.86
Middle-Lower Whippany	Agriculture	.50	1.28
	Barren Land	.14	.36
	Forest	11.04	28.16
	Urban Land	25.05	63.9
	Water	.16	.41
	Wetlands	2.31	5.89
Troy Brook	Agriculture	.11	.69
	Barren Land	.03	.19
	Forest	4.18	26.14
	Urban Land	8.94	55.91
	Water	.59	3.69
	Wetlands	2.14	13.38

Land Use Categories are defined as follows:

Urban land is characterized by intensive land use where the landscape has been altered by human activities. It includes residential; commercial and services; industrial; transportation, communication and utilities; mixed urban or built-up land; other urban or built-up land; and recreational land. . Included with each of the above land uses are associated lands, buildings, parking lots, athletic fields, access roads, etc.

Agricultural land includes all lands used primarily for the production of food and fiber and some structures associated with this production. Subcategories

include cropland and pastureland; orchards, vineyards, nurseries and horticulture areas; and confined feeding operations.

Forest delineates any lands covered by woody vegetation other than wetlands.

Water represents all areas within the land mass periodically covered by water. This category includes river channels; lakes or ponds; reservoirs; and bay/estuaries.

The wetlands are those areas that are inundated or saturated by surface or ground waters at a frequency and duration sufficient to support vegetation adapted for life in saturated soil conditions. Coastal and interior wetlands are the two subcategories based on the location relative to a tidal water system.

Barren lands are characterized by thin soil, sand or rocks and a lack of vegetative cover in a non-urban setting. Extractive mining operations, landfills and other disposal sites compose the majority of man-altered barren lands. Barren land such as beaches and rock faces are also included in this category.

The Upper Whippany subwatershed is over 60 percent forest covered, most of which is classified as deciduous forest. Urban land use accounts for another 30 percent of the subwatershed. Residential land use is the majority of this category.

The Middle-Lower Whippany subwatershed is also over 60 percent urban. Forest cover makes up another 30 percent of the subwatershed. Wetlands comprise over 5 percent of the subwatershed and are characterized by non-tidal marshes for the most part. Black Meadows is located in this subwatershed.

Over 50 percent of the Troy Brook subwatershed is urban while wetlands and forest comprise most of the other half of the land use in the subwatershed. Troy Meadows and part of Hatfield Swamp are located in this subwatershed.

Water Supply

Based upon information contained within the August *1996 New Jersey Statewide Water Supply Plan*, the total current average water supply demand (1990) in the watershed is approximately 27.3 MGD. There is only one surface water withdrawal for potable use in the watershed: the Southeast Morris County Municipal Utilities Authority, which diverts water from the Clyde Potts Reservoir (Harmony Brook) in Mendham Borough. This water is utilized by Morristown, Morris Township and Mendham Township. The generated wastewater is sent to the Morristown STP for treatment and subsequent discharge back into the Whippany River in a non-depletive manner. Although the Clyde Potts Reservoir is not frequently used as a water supply source, the Southeast Morris County Municipal Utilities

Authority has the capability to divert 4 MGD from it. When water is diverted, water demand does not usually exceed 1.5 MGD.
Ground water is the most common use of the water supply in the Whippany River Watershed. Approximately 23.4 MGD is withdrawn from the aquifers that underlie the watershed. The majority of the withdrawals are for potable supply (20.3 MGD), while the remaining amount is used for industrial (3.0 MGD) and agricultural (0.1 MGD) purposes.

Approximately 7.3 MGD of the 23.4 MGD of ground water that is withdrawn from within the watershed is depletive in nature. Depletive water use is simply the amount of surface or ground water withdrawn from a selected geographic area that is used for water supply and disposed of in such a way that it can no longer be utilized again in that particular geographic area. Current ground water investigations indicate that these depletive ground water withdrawals may cause streamflow reductions within the watershed. The remainder of the watershed's demands (2.4 MGD) is met from sources that are transferred in from outside of the watershed.

WATER QUALITY ASSESSMENT

Water quality assessments of the Whippany Watershed presented here are based upon three principal sources. As the other watersheds assessed in this report, information is gathered from the fixed-station ambient physical/chemical monitoring network and a macroinvertebrate biological monitoring network. The third information source is a supplemental watershed-specific intensive monitoring and assessment process that represents an outcome of the Whippany Watershed pilot program. Many of the final conclusions regarding overall water quality within this watershed are the result of this latter study.

Physical/Chemical Water Quality

Locations: Whippany River at Morristown and Pine Brook

Dissolved Oxygen: Acceptable at both locations. Overall dissolved oxygen levels are lower at Pine Brook than at Morristown.

Temperature: No violations of the upper criterion for non-trout waters at either locations.

Nutrients: Total phosphorus is elevated at both locations. At Morristown, 60% of samples exceeded the criterion and the median value was 0.125 mg/l. At Pine Book, 84% of total phosphorus samples were over the criterion and the median value was 0.28 mg/l. Inorganic nitrogen was slightly elevated at both locations; the medians were 1.5 mg/l and 1.85 mg/l at Morristown and Pine Book, respectively.

Bacteria: Highly elevated at both locations. Geometric means of fecal coliform records were 599 MPN/100 ml and 433 MPN/100 ml at Morristown and Pine Book, respectively.

Sodium: Elevated but within the criterion at Morristown where the median value was 26 mg/l. At Pine Brook, 10% of samples exceeded the criterion and the median value was 34.5 mg/l. High values were not restricted to winter periods but occurred in summer and fall as well.

Whippany River at Morristown and Pine Brook continued:

Heavy Metals: Traditional sampling methods and laboratory analyses of total recoverable metals indicated violations of lead criteria (chronic) at Morristown and both lead and copper (both for chronic) at Pine Brook. However, recent supplemental sampling using "clean" field and laboratory techniques and analyses for the dissolved form of the metals uncovered no violations of either acute or chronic criteria at any of the numerous sampling locations.

Other: Two elevated pH recordings were observed at Morristown. Levels of 8.8 SU and 8.9 SU were recorded in the spring of 1992.

Summary: Based upon current physical/chemical monitoring, the Whippany, as monitored at Morristown and Pine Brook, still experiences elevated total phosphorus and poor sanitary quality as reflected by excessive bacterial levels. The use of the water for drinking is threatened by high sodium levels.

Biological Monitoring

Macroinvertebrate assessments indicate that the upper section of the Whippany mainstem is non-impaired. Beginning at Ridgedale Ave in Morristown down to the river's termination, the river is assessed to be moderately impaired. Conditions in Morristown represent an improvement over conditions observed in 1985 and 1990, when the location was assessed to be severely impaired. Tributaries to the Whippany, Troy Brook and Watnong Brook are assessed to be largely moderately impaired. One station on Watnong Brook (Old Dover Road in Morris Township) was found to be non-impaired.

An Historical Perspective on Water Quality

Comparisons of dissolved oxygen (DO) levels between 1973 and 1995 indicate that DO increased significantly between 1973 and 1980, and then again from 1980 to 1995. These are believed to be the results of the substantial upgrades to the wastewater treatment systems that have occurred within the watershed and the corresponding substantial reductions in the discharge of oxygen demanding materials (see *Point Source Assessment*, below). These reductions are reflected in reductions in in-stream biological oxygen demand (BOD) of some 80% in twenty years in the Whippany River.

Although there has been a general reduction in the loading of phosphorus from point sources, the in-stream concentrations have continued to increase over the past 20 years. It is suspected these additional phosphorus loadings may be emanating from nonpoint sources such as fertilizers, groundwater discharges, wildlife populations (such as pond waterfowl) surface runoff, the re-suspension of bottom material and ineffective stormwater management.

POINT SOURCE ASSESSMENT

Sewage Treatment Plants and Stormwater Systems

Six municipal wastewater treatment plants, 25 institutional sanitary plants and one stormwater facility discharge into the Whippany River or its tributaries. The Parsippany-Troy Hills Sewage Treatment Plants handles the greatest volume while Saint Mary's Abbey has the least maximum flow based upon monthly averages.

Starting in 1988 upgrades began on the four large sewerage facilities in the watershed. By 1992 all four facilities had attained tertiary or advanced status. Currently these advanced facilities employ chlorinating and/or ultra-violet disinfection methods. All four plants use the Parsippany-Troy Hills facility for sludge incineration.

Several sewage treatment plants serve municipalities in the Whippany River Watershed but do not discharge into the Whippany River. Morris Township, which operates the Butterworth STP, also operates the Woodland STP which discharges into Loantaka Brook, a Passaic River tributary. The Florham Park Sewerage Authority serves the entire borough and discharges into the Passaic River. The sanitary waste from both Madison Borough and Chatham Township also flows into the Passaic River after it is processed by the Madison-Chatham Joint Meeting Treatment Plant.

In the late 1980s all six of the larger sewage treatment plants underwent extensive upgrades. The total cost of these upgrades was between $150,000,000 and $200,000,000.

Industrial Permit Holders

For the most part the 32 permit holders in the watershed can be classified as small dischargers. In the Whippany River Watershed processes range from backwashing swimming pool filters to metal plating. Some of the following are notable and salient components of the waste-streams generated in the watershed. Colloid Chemical is permitted to release several metals including copper and chromium. Litton Industries also holds a permit for solvents, vinyl chloride and several toxic substances including arsenic and cyanide.

Pollutant Loading From Point Sources - Historical Perspective.

Comparisons were made of point source loadings during the 1970s and 1994 so as to analyze the changes that have occurred in municipal and industrial discharges as a result of some 20 years of point source management by the Department. Municipal treatment plant discharges were compared in terms of carbonaceous biochemical oxygen demand (CBOD) and nitrogenous biochemical oxygen demand (NBOD). Industrial discharges were analyzed using chemical oxygen demand (COD). Results are tabled below.

Municipal Facilities (Excluding Parsippany-Troy Hills)

Discharge/ Constituent	1970s Loading	1994 Loading	Percent Increase or Reduction
Flow, MGD	5.58	6.22	11.5% Increase
CBOD, lbs/day	1,602	219.3	86.3% Reduction
NBOD, lbs/day	2,774	56.3	98.0% Reduction
Total P, lbs/day	206	127	38.3% Reduction

Parsippany-Troy Hills STP

Discharge/ Constituent	1970s Loading	1994 Loading	Percent Increase or Reduction
Flow, MGD	4.75	12.75	158% Increase
CBOD, lbs/day	2250	282	87.5% Reduction
NBOD, lbs/day	4990	73.8	98.5% Reduction
Total P, lbs/day	186	347	87% Increase **(see note below)**

Note: This STP is located on the far downstream portion of the Whippany River. Its pollutant load is of little significance to the Whippany as a whole but is an issue impacting the Passaic River downstream.

Industrial Facilities (Estimated)

Discharge/ Constituent	1970s Loading	1994 Loading	Percent Increase or Reduction
Flow, MGD	9.5	1.86	80% Reduction
COD, lbs/day	6894	119	98% Reduction
CBOD*, lbs/day	6205	132	98% Reduction

***** CBOD = COD x 0.9

The data indicate that for municipal wastewater, pollutant loadings of oxygen-demanding materials and phosphorus have been reduced substantially within the watershed. At the same time total wastewater flow has increased. Note that although phosphorus loadings have increased at the Parsippany-Troy Hills STP, this nutrient burden is more of an issue for the Passaic River due to the extreme downstream location of this treatment plant on the Whippany. Industrial facilities have shown a substantial reduction in both total flow and oxygen-demanding load.

The following is a summary of wastewater treatment plants that have been recently upgraded and/or expanded and have renewed operation:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Hanover SA	HanoverTwp., Morris Co.	Whippany River	Treatment system has been upgraded via an ACO executed with the DEP. Upgrades were required due to violations of effluent limitations. Upgrade completed in July 1992.

Treatment plants continued:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Morristown STP	Morristown Twp., Morris Co.	Whippany River	Treatment system has been upgraded via an ACO executed with the DEP. Upgrades were required due to violations of effluent limitations. Upgrade completed in June 1992.
ParTroy STP	Parsippanny Twp., Morris Co.	Whippany River	Treatment system has been upgraded via an ACO executed with the DEP. Upgrades were required due to violations of effluent limitations. Upgrade completed in December 1995.
Butterworth STP	Morris Twp., Morris Co.	Whippany River	Treatment system has been upgraded via an ACO executed with the DEP. Upgrades were required due to violations of effluent limitations. Upgrade completed in July 1992.
N.J. Psychiatric Institution (Greystone)	Parsippany Twp., Morris Co.	Jackqui Pond	Facility has completed an upgrade of its wastewater treatment system via an ACO executed with the Department.

Permit Compliance

Only one facility is under enforcement action for discharging improperly treated wastewater:

FACILITY	LOCATION	RECEIVING WATER	POLLUTANT	COMMENTS
St. Mary's Abbey, Delbarton School	Morris Twp., Morris Co.	un-named trib. to the Whippany River	Ammonia, nitrogenous BOD	Facility was to upgrade in accordance with a 1988 ACO. The ACO was amended in 1994, allowing St. Mary's to tie into the Morris Twp. collection system. Facility is awaiting an amendment to water quality management plan to allow the tie-in.

NONPOINT SOURCE ASSESSMENT

Urban/suburban development is suspected of degrading the water quality of the Whippany River in its upper reaches and is known to have a severe impact in the river's lower section. Upstream of Speedwell Lake, runoff from construction activity, stormwater discharges, urban surfaces, and the loss of riparian vegetation are all suspected of contributing to siltation in the river. This in turn has led to a reduction in the trout holding capacity of the waterway. In the lower end below Speedwell Lake, urban runoff and chemical spills have resulted in severe siltation and an overall degradation of the river's water quality. The lower Whippany River is reported to have had a long history of fish kills caused by industrial and municipal pollution. Few game fish are said to inhabit this portion of the river as reported back in the late 1980s; in their stead pollution-tolerant forms such as carp and pan fish were reported to be inhabiting the river. Speedwell Lake and the wetland areas of the Whippany River Watershed (Black and Troy Meadows) are known to be receiving severe runoff from construction activity and from local storm sewers.

DESIGNATED USE ASSESSMENT

The Whippany River will fully support the "aquatic life" designated use in the portions upstream of Ridgedale Ave. in Morristown. From this point downstream the river only partially supports the use. Troy Brook and

Watnong Brook also partially support the use. The river will not achieve swimmable status because of fecal coliform concentrations.

BIOLOGICAL ASSESSMENT TABLE: AREA 6

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
6	21	AN0213	Passaic R	Tempewick Rd	Mendham Twp	Feb 5, 1992	moderately impaired
6	21	AN0214	Indian Grave Bk	Hardscrabble Rd	nr Bernardsville	Feb 5, 1992	non-impaired
6	21	AN0215	Primrose Bk	Jockey Hollow Nat'l Pk	Jockey Hollow	Aug 20, 1991	non-impaired
6	21	AN0215	Primrose Bk	Jockey Hollow Nat'l Pk	Jockey Hollow	Nov 14, 1991	non-impaired
6	21	AN0215	Primrose Bk	Jockey Hollow Nat'l Pk	Jockey Hollow	Feb 4, 1992	non-impaired
6	21	AN0215	Primrose Bk	Jockey Hollow Nat'l Pk	Jockey Hollow	May 19, 1992	non-impaired
6	21	AN0216	Primrose Bk	Lees Mill Rd	Harding Twp	Feb 6, 1992	moderately impaired
6	21	AN0217	Gr Bk	Blackwells Pl	Harding Twp	Feb 6, 1992	non-impaired
6	21	AN0218	Gr Bk	Blackberry Ln	Harding Twp	Feb 6, 1992	moderately impaired
6	21	AN0219	Gr Bk	Woodland Rd (Gr Swamp WMA)	Harding Twp	Feb 6, 1992	moderately impaired
6	21	AN0220	Loantaka Bk	Bluestone Terr	Morristown Twp	Feb 7, 1992	severely impaired
6	21	AN0221	Loantaka Bk	Green Village Rd	Green Village	Feb 7, 1992	moderately impaired
6	21	AN0222	Black Bk	Southern Blvd	Harding Twp	Feb 7, 1992	severely impaired
6	21	AN0223	Black Bk	New Vernon Rd	Meyersville	Feb 7, 1992	severely impaired
6	21	AN0224	Passaic R	Valley Rd	nr Millington	Feb 5, 1992	non-impaired
6	21	AN0224	Passaic R	Valley Rd	nr Millington	May 19, 1992	non-impaired
6	21	AN0224	Passaic R	Valley Rd	nr Millington	Dec 9, 1992	non-impaired
6	21	AN0224	Passaic R	Valley Rd	nr Millington	Aug 11, 1993	non-impaired
6	21	AN0225	Dead R trib	Somerville Rd (Liberty Cor)	Bernards Twp	Aug 27, 1991	non-impaired
6	21	AN0225	Dead R trib	Somerville Rd (Liberty Cor)	Bernards Twp	Nov 14, 1991	non-impaired
6	21	AN0225	Dead R trib	Somerville Rd (Liberty Cor)	Bernards Twp	Feb 4, 1992	non-impaired
6	21	AN0225	Dead R trib	Somerville Rd (Liberty Cor)	Bernards Twp	May 19, 1992	non-impaired
6	21	AN0226	Dead R	Somerville Rd (Liberty Cor)	Bernards Twp	Aug 20, 1991	non-impaired
6	21	AN0226	Dead R	Somerville Rd (Liberty Cor)	Bernards Twp	Nov 14, 1991	non-impaired
6	21	AN0226	Dead R	Somerville Rd (Liberty Cor)	Bernards Twp	Feb 4, 1992	non-impaired
6	21	AN0226	Dead R	Somerville Rd (Liberty Cor)	Bernards Twp	May 19, 1992	moderately impaired
6	21	AN0226	Dead R	Somerville Rd (Liberty Cor)	Bernards Twp	May 5, 1994	moderately impaired
6	21	AN0227	Dead R	King George Rd	nr Mt Bethel	Feb 5, 1992	moderately impaired
6	21	AN0228	Passaic R	S Main Ave	Stirling	Nov 20, 1989	moderately impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
6	21	AN0229	Passaic R	Stanley Ave	Chatham	Jun 11, 1990	severely impaired
6	21	AN229A	Passaic R	Mountain Ave	Gillette	Nov 20, 1989	moderately impaired
6	21	AN229B	Passaic R	Snyder Ave	Berkeley Twp	Nov 17, 1989	moderately impaired
6	21	AN229C	Passaic R	Fairmount Ave	Long Hill	Jun 11, 1990	severely impaired
6	21	AN0230	Passaic R	Summit Ave	Chatham	Jun 12, 1990	severely impaired
6	21	AN230A	Passaic R	Watchung Ave	Chatham	Jun 12, 1990	severely impaired
6	21	AN0231	Passaic R	Eagle Rock Ave	E Hanover Twp	Nov 17, 1989	moderately impaired
6	21	AN231A	Passaic R	Passaic Ave	Florham Pk	Jun 12, 1990	severely impaired
6	21	AN231B	Passaic R	Old Mt Pleasant Ave	E Hanover Twp	Nov 17, 1989	severely impaired
6	23	AN0232	Whippany R	Mt Pleasant Rd	Mendham Twp	Jul 7, 1993	non-impaired
6	23	AN0233	Whippany R	Whitehead Rd	Morris Twp	May 16, 1985	non-impaired
6	23	AN0233	Whippany R	Whitehead Rd	Morris Twp	May 22, 1990	non-impaired
6	23	AN0234	Whippany R	Ridgedale Ave	Morristown	Apr 17, 1985	severely impaired
6	23	AN0234	Whippany R	Ridgedale Ave	Morristown	May 22, 1990	severely impaired
6	23	AN0234	Whippany R	Ridgedale Ave	Morristown	Nov 9, 1993	moderately impaired
6	23	AN234A	Watnong Bk	Lake Rd	Morristown	Nov 9, 1993	moderately impaired
6	23	AN234A	Watnong Bk	Lake Rd	Morristown	Sep 8, 1994	moderately impaired
6	23	AN234B	Watnong Bk	W Hanover Rd	Morris Twp	Sep 8, 1994	moderately impaired
6	23	AN234C	Watnong Bk	Old Dover Rd	Morris Twp	Sep 8, 1994	non-impaired
6	23	AN0235	Whippany R	Jefferson Rd	Hanover Twp	Apr 19, 1985	severely impaired
6	23	AN0235	Whippany R	Jefferson Rd	Hanover Twp	May 22, 1990	moderately impaired
6	23	AN0235	Whippany R	Jefferson Rd	Hanover Twp	Nov 9, 1993	moderately impaired
6	23	AN0236	Troy Bk	Lake Rd	Mtn Lks	Jul 13, 1993	moderately impaired
6	23	AN0237	Troy Bk	Beaverwyck Rd	Troy Hills	Jul 13, 1993	moderately impaired
6	23	AN0238	Whippany R	Edwards Rd	E Hanover Twp	Apr 16, 1985	moderately impaired
6	23	AN0238	Whippany R	Edwards Rd	E Hanover Twp	Jul 7, 1993	moderately impaired
6	12	AN0239	Russia Bk	Milton - Dover Rd	Jefferson Twp	Jul 22, 1993	non-impaired
6	12	AN0240	Rockaway R	blw Longwood Lk	Jefferson Twp	Jul 22, 1993	moderately impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
6	12	AN0241	Rockaway R	Berkshire Valley Rd	Jefferson Twp	Jul 20, 1993	moderately impaired
6	12	AN0242	Green Pd Bk	Mt Pleasant Tnpk	Wharton	Jul 20, 1993	moderately impaired
6	12	AN0243	Rockaway R	Blackwell St (Rt 513)	Randolph Twp	Jul 20, 1993	non-impaired
6	12	AN0244	Mill Bk	Palmer Rd	Randolph Twp	Jul 20, 1993	non-impaired
6	12	AN0245	Beaver Bk	Lyonville Rd	Meriden	Jul 15, 1993	non-impaired
6	12	AN0246	Beaver Bk	Morris Ave	Denville	Jul 15, 1993	moderately impaired
6	23	AN0247	Den Bk	Mt Pleasant Tnpk	Denville	Jul 20, 1993	severely impaired
6	12	AN0248	Rockaway R	Pocono Rd	Denville	Jul 15, 1993	non-impaired
6	12	AN0249	Stony Bk	Valley Rd	Boonton Twp	Jul 15, 1993	moderately impaired
6	12	AN0250	Rockaway R	Morris Ave	Boonton	Jul 16, 1993	non-impaired
6	12	AN0251	Rockaway R	River Rd	Boonton	Jul 16, 1993	moderately impaired
6	12	AN0252	Crooked Bk	Hemlock Rd	Montville Twp	Aug 3, 1993	non-impaired
6	12	AN0253	Crooked Bk	Vista Rd	Montville Twp	Jul 13, 1993	moderately impaired
6	12	AN0254	Crooked Bk	River Rd	Montville Twp	Jul 13, 1993	moderately impaired